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Department of Health Services
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California Morbidity

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Pete Wilson, Governor

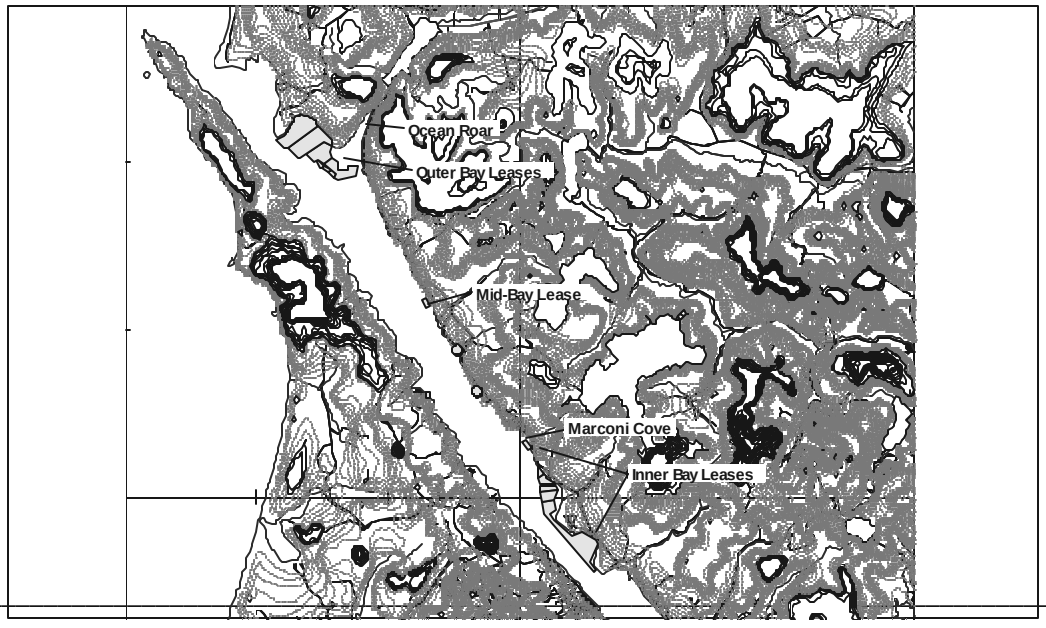
GASTROENTERITIS ASSOCIATED with TOMALES BAY OYSTERS INVESTIGATION, PREVENTION, and CONTROL

NOTE: The version of this **CM** note as initially published contained two errors, both on the last page, in the last and next-to-last paragraphs.

The California Department of Health Services (DHS) was first informed about a foodborne illness outbreak associated with the consumption of raw oysters from Tomales Bay, Marin County, on May 13, 1998. When additional illnesses were reported the next day, DHS' Environmental Management Branch (EMB) immediately closed the six commercial shellfish growers in Tomales Bay to harvesting. The total number of cases eventually reached 171 in 44 clusters from 7 counties. DHS launched an investigation that involved participation by the Division of Communicable Disease Control, the Division of Drinking Water and Environmental Management, the Division of Food, Drug, and Radiation Safety, and several local county health departments. The activities pursued by these groups included case investigation, traceback of product linked to illness from the marketplace back to the growing area leases, and a sanitary survey of the growing areas and surrounding watershed. Analyses were performed on clinical specimens, oysters recovered from the market, and environmental samples to help determine the causative agent. Potential agents initially included viral pathogens, bacterial pathogens, and marine biotoxins. The following summarizes those findings and the steps that were taken to permit reopening of Tomales Bay to shellfish harvesting.

Tomales Bay is a long narrow estuary, approximately 11 miles long that varies from one to two miles wide, located 50 miles north of San Francisco in Marin County (see Figure). There are currently six certified shellfish growers in the bay, and all but one operate on state leases located on the east shoreline. Immediately following the harvest closure, DHS requested all harvest logs from those growers. An audit of these logs, together with illness reports and the product traceback data, helped DHS determine that all of the reported illnesses were linked to oysters harvested from the mid to outer bay. Conversely, there was no evidence of a link between illness and shellfish harvested from the inner bay leases. When water and shellfish samples collected after the harvest closure were found to consistently meet the National Shellfish Sanitation Program standards, DHS reopened the inner bay leases for harvesting on June 9. DHS'

Figure.
Map of Tomales Bay



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field investigation then focused on the outer and mid bay regions, which remained closed.

Onsets occurred between May 1 and May 25, with the majority occurring by May 14. During that time there were approximately 84,500 oysters harvested from Tomales Bay; 52,000 originated from the implicated leases in the mid to outer bay. There were 10 stool samples from patients submitted to DHS, but only three were suitable to analyze for viruses (such as caliciviruses) by electron microscopy. All three were negative. Likewise, these stool samples were found to be negative for a variety of bacterial pathogens, including *Salmonella*, *Shigella*, *Campylobacter*, and all species of naturally occurring *Vibrio* when analyzed at various local health departments and at DHS. The *Vibrio* results were not surprising, as water temperatures within Tomales Bay during the outbreak period were between 15°C and 18°C, which is much cooler than temperatures normally associated with the proliferation of *V. parahaemolyticus*. In addition, the commercial growers had been conducting their own periodic analyses for *Vibrio* species prior to the outbreak, all of which were negative.

Two stool samples were sent to the Centers for Disease Control and Prevention, in Atlanta, which used a reverse transcription polymerase chain reaction (RT-PCR) method for identifying small round structured viruses (SRSVs). One of the two samples was found to be positive for the Group 2 calicivirus (whereas Norwalk agent is in Group 1). Furthermore, convalescent sera sent for study to researchers at the University of Massachusetts revealed 2 of 17 samples from outbreak-related cases with very high IgM titers to Group 2 caliciviruses.

A variety of oyster samples recovered from the growers' voluntary recall efforts were submitted for study at the U.S. Food and Drug Administration (USFDA) laboratories in Alabama and California for SRSVs. Of three samples submitted, two (both harvested on May 5) were found to be positive for Group 2 calicivirus.

The potential link between the outbreak and a viral pathogen (calicivirus, Group 2) that has humans as its only known reservoir allowed DHS to focus on sanitary aspects of Tomales Bay, with an aim of finding human sources of contamination. Based on existing knowledge of the bay and additional shoreline survey work, DHS determined that the two most likely causes for the outbreak were the substandard and potentially failing septic systems along the shoreline **or** overboard discharge(s) of toilet wastes from a recreational or commercial boater. To address the concern of contamination by boaters, DHS interviewed all commercial kayaking companies that are known to operate on Tomales Bay. These companies obtain a use permit from the National Park Service (NPS) and are provided informational leaflets on the proper handling of waste. Each company claims to use sealed marine sanitation devices for overnight camping trips. All such devices are self-contained and are to be safely transported from the bay to an onshore disposal facility several miles from the bay. Private kayakers are not currently regulated by NPS and could represent the greatest potential risk, as could non-permitted commercial kayaking companies that may be operating in the bay. During the Department' s investigation, we received reports from two people who, over the past three years, had each found a plastic bag on the bay that possibly contained human waste. These incidents indicate a potential for contamination of the shellfish growing areas by improper handling and disposal of waste by users of Tomales Bay. Due to the lack of adequate sanitary facilities at the majority of undeveloped campsites on the west shore, there is probably a greater risk of improper waste disposal or transport there than elsewhere along the shoreline of the bay.

In addition to potential impact from kayakers and campers, the Department investigated the likelihood of contamination from recreational boats. Conversations with the California Department of Fish and Game revealed that most recreational fishing trips inside Tomales Bay are four to five hours in length and are based on tide changes. The preferred fishing grounds are primarily within two miles of the boat launch, where the Marin County Parks and Recreation Department (MCPRD) maintains several portable toilets. Additionally, many recreational boaters use the bay as a launch site, then exit the bay for open ocean fishing. For these reasons the Department determined that this group of users was less likely to be a source of fecal contamination to the bay.

DHS convened a special meeting on August 5 with representatives from federal, state, and county agencies, and from the commercial shellfish industry, to discuss short-term and long-term improvements related to boating and camping activity. The NPS had already implemented some improvements, e.g., the permit system for commercial kayaking companies, and NPS is in the process of developing others. For example, NPS has also proposed a permit system for camping, as well as a reduction in the number of existing campsites. NPS stated

that their patrol efforts would increase dramatically next spring in support of the kayaking and camping permit system. The NPS has also agreed to modify their kayaking leaflet to include information on the location of portable toilets around the bay. The NPS and MCPRD will provide additional signs and information at major launch sites around the bay. The Regional Water Quality Control Board (RWQCB) and MCPRD are investigating the application process to obtain funds from the federal Clean Water Act to install marine pump-out stations at several locations. When this is accomplished, RWQCB will initiate the process to have Tomales Bay officially declared a "no discharge" zone by the federal Environmental Protection Agency.

Calculations by DHS indicate that SRSVs shed by one person could contaminate a shellfish growing area one mile away with infectious quantities of virus, and waste from two or more people could contaminate an area at least 2.5 miles away. DHS' shoreline survey identified 35 houses within two miles of the affected leases. DHS developed a "Plan of Action for Determining the Impact from On-site Sewage Disposal to Shellfish Growing Areas in Tomales Bay" and provided this to the county environmental health department and RWQCB. Using this document as a guide, DHS reviewed 80 parcels on the east shore of Tomales Bay from Ocean Roar to Marconi Cove (see Figure), ranking them on a scale from "0" to "3." A ranking of "0" indicated little potential of a negative impact while a ranking of "3" indicated a high likelihood of a negative impact on the water quality of the shellfish growing areas from the on-site sewage disposal system and the need for a field visit to confirm this potential. A total of 71 (89%) of the 80 parcels reviewed were classified as "3' s."

DHS met with the commercial shellfish growers and established criteria for reopening the closed leases in the mid and outer bay. The first criterion was evidence that SRSVs were no longer present in the closed leases, and the second criterion was a strong commitment by RWQCB and Marin County to work aggressively to correct identified problems with septic systems around the bay.

DHS, in cooperation with the shellfish growers, collected oysters from all affected leases on June 12 for SRSV analysis by RT-PCR at the USFDA lab in Alameda. Split samples were also sent to the University of North Carolina at Chapel Hill for RT-PCR analysis and detection of enteric viruses by cell culture techniques. Both laboratories reported no detectable SRSVs in any of the shellfish samples. A second series of oyster samples were collected on July 13 and these were also submitted to USFDA for SRSV analysis. These samples were also negative for SRSVs.

DHS had earlier obtained a commitment from the Executive Officer of the San Francisco office of RWQCB, which is responsible for protecting the waters of Tomales Bay for beneficial uses, to work aggressively to eliminate potential sources of human sewage contamination of Tomales Bay shellfish growing areas. On August 3, DHS received a similar commitment from Marin County, which is responsible for permitting and regulating on-site sewage disposal systems with oversight by the RWQCB. . On August 4, DHS notified all commercial shellfish growers that the closed leases in the mid and outer bay could again reopen for commercial shellfish harvesting.

DHS is hopeful that the combined efforts of all involved agencies, the commercial shellfish growers, and local community members will result in a significant reduction in the risk of contamination to the bay from human sewage. DHS has made it clear that serious measures may be necessary in cases where homes are found to have improper on-site wastewater treatment. Measures may be necessary to prevent these sewage systems from being used until such time as improvements or repairs have been made to eliminate or minimize the threat posed to the shellfish growing waters of Tomales Bay. Long-term solutions should also be explored, such as initiation of community wastewater treatment systems or other acceptable alternatives.

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Note to Authors: Articles should be submitted to CM Editor, DCDC, CA Department of Health Services, 2151 Berkeley Way, Berkeley, CA 94704.